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X-RAY SATELLITE (ROSAT)
STATUS REPORT, 4TH QUARTER 1985

Deutsche Forschungs- und Versuchsanstalt
fuer Luft- und Raumfahrt DFVLR (German
Aerospace Research Establishment)

Translation of: "Roentgensatellit Statusbericht; 4. Quartal 1985", DFVLR Report No. RF-TN 4, Porz-Wahn West Germany, December 31, 1985, pp. 1-68

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16. Abstract

An overview of the current status of the ROSAT X-Ray satellite project is given. Areas discussed include an overview of problem areas, systems and mechanical subsystems, the electrical subsystem, power supply, data processing and transmission, the wide field camera, ground support equipment and the production scheduling. It is shown that the project is proceeding according to schedule, including the hardware production and costs. However, it is stated that estimated additional costs will exceed the plan. The previous schedule for production of the flight model will no longer be met. A modified milestone plan has been worked out with Dornier Systems. The current working schedule calls for a launch date of December 21, 1987; however, this does not take into account a 4-week buffer prior to transporting the flight model to the launch site. As of the date of this report, milestone M5 has been met. Previous problems with the gold vapor deposition on the flight model mirror due to contamination have been eliminated.

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1.0 Overview and Prospects

1.1 Status of Tasks

Summary

With respect to the engineering job, the project is following the intended plan. The ROSAT total costs, including Supplementary Contract No. 5 (in process) and proposals for changes in the master contract received to date, are also within the specified plan; however the runout cost estimate (EAC 3) shows that the estimated additional costs in the master contract will exceed the envelope of the specified plan. The previous schedule for the production of the flight model can no longer be met. There has been an agreement with DS for a binding schedule plan with a modified milestone plan at the end of February 1986 upon conclusion of the solar simulation tests on the STM. In the meantime a planning proposal from DS will be used as a basis for work which shows a launch date of 21 December 1987, not taking into account a four-week buffer prior to transporting of the flight unit to the launch site.

Documentation

Project Plan:
Due to some reservations about the data processing concept during the mission, the project plan has not yet been submitted to DFVLR management.

Test and Integration EM/QM/STM Phase

The execution of the STM system tests is in accordance with the previous planning status with some partially readjusted operating sequences. The integrated system test (IST) was successfully concluded. The electrical ground support equipment (EGSE) with associated software was accepted simultaneous with the IST.

Test and Integration FM Phase

The delivery of the NASA-furnished flight hardware (RSGF, SURS) has been finished.

Reviews

The status review was carried out in November at the prime contractor.

Milestones

Milestone M5 was met on schedule. A design review at the prime contractor, using the test result presented and the analyses done, showed that all design specifications were proven to be attained or attainable.

Problems

An adjustment is required for the cost plan envelope and the FM-schedule to match the current status. Also GSOC personnel planning must be adjusted to the current status.

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1.2 Prospects

In the course of the next quarter a binding milestone plan is to be determined with the prime contractor which accords with the current schedule for the FM-Phase.

As part of the EM integration procedure, there will be carried out with the STM the solar simulations tests, the postponed EMC tests and, if needed, additional systems functional tests. Following this the STM will be dismantled.

Irregularities in the gold vapor deposition on the flight mirror have been successfully eliminated, to the extent that they could be traced to contamination before or after the gold vapor deposition; following this, further contamination was determined during gold vapor deposition which must be more precisely identified and eliminated by the responsible offices.

1.3 Problem Overview

Area	Problem Area	NEW	CLOSED
1. Management	- at the moment no problems at prime contractor		
2. System	- agreement pending with NASA on HRI random test loads		X
	- failure of high vacuum in the HRI detector with ion pump connected require explanation and correction		
	- time delays in the delivery of the FI-FM require explanation and determination of corrective measures		X
3. Mechanical subsystem	- no problem at the moment		
4. Electrical subsystem	- failure of furnace-stabilized quartz in the data processing must be explained in order to guarantee that on the FM satisfactory operational assurance is present at this "single point failure" site.		X
	- exceeding of temperature limits on solar generator when payload bay is open in the shuttle and with direct solar radiation into it requires remedy by changing shuttle orientation in the PIP.		

1.3 Problem Overview

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Area	Problem Area	NEW	CLOSED
5. Telecope	- stray light specifications of the star sensor in the AKS cannot be met in present form and require discussion		X
	- assembly of the FM mirror system interrupted due to irregularities in the gold vapor deposition of paraboloids P3 and P4		
6. Assembly Integration	- current unavailability of the IABG test chamber for the solar simulation test at the planned time will require expensive substitute measures		X
7. Ground support equipment	- no problems at the moment		
8. Mission safety	- no problems at the moment		
9. Vehicle interface	- no problems at the moment		
10. Mission operations	- mission operation and simulator development are suffering personnel shortage		
	- open action item on data processing concept		

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Area	Problem Area	NEW	CLOSED
11. Schedule	- deadline postponements have been reported for the data processing and component procurement subsystems - a postponement of milestone M7 can be assumed based on problems with the gold vapor deposition of the FM mirror system. Further impacts on the FM schedule must be clarified.		

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2.0 System

- System Verification

  As a submission for the review of milestone M5, the prime contractor produced an exhaustive document which shows in detail in tabular form those documents (engineering notes, analyses and test reports) in which it has been shown that the current design is oriented on the specifications for system and subsystems.

- System Magnitudes

  The magnitudes for attitude measurement accuracy produced for the system verification mentioned above, which contained the very positive test results on the EM star sensor, showed that the required attitude measurement accuracy can be achieved.

  The other system magnitudes also exhibit satisfactory clearances within the specified limits.

- EMC Activities

  During EMC tests at the component level, specified values were exceeded in a few cases. Now it was demonstrated during system test (IST) that these excesses do not lead to problem at the system level and therefore can be accepted.

  In preparation for the EMC tests for the spring of '86, tasks were started for delivery of the required hardware and for working up the system EMC test procedure.

3.0 Mechanical Subsystems /9/

3.1 Structure/Mechanisms

Evaluation of the modal survey tests took place employing a mass matrix corresponding to the current status of the satellite in which a total mass of m = 2390 kg has been determined. The comparison shows good agreement of the measured characteristic frequencies and forms with those magnitudes derived analytically. All major characteristic frequencies agree within a deviation < 10%. The Modal Survey Test fully validated the Finite Element

Model (FEM).
As was determined before the test, this result makes possible elimination of adjustment of the FEM.

The test report on the static load was finished and presented. In addition reports on structural stability and fracture mechanics were completed. The FM drawing package was completed. A start was made on fabrication of the piece parts for refurbishment of the structure. The FM solar generator was finished and sent to DM for thermal treatment.

In the case of the mechanisms, fabrication of the flight models of ABM, TDM and SSM was continued according to plan. The assembly of the Telescope Door Mechanism (TDM) was able to be almost completely finished. Assembly instructions for the ABM and verification control sheets were prepared.
No problems exist at the moment in the two subssystems.

3.2 Thermal Budget /10/

Tasks in the thermal budget subsystem were continued according to plan. Preparations for solar simulation test included matching of the reduced ROSAT thermal model to the test chamber conditions at IABG-WSA and the fabrication and integration of thermal and test hardware. It was possible to complete all necessary tasks in the thermal sector in a timely manner before the test.

It was possible to overcome difficulties in procurement of white paint for thermal treatment of the FM solar generators by the use of a similar paint from another manufacturer. Meanwhile, it was possible to deliver the solar generators to AEG for installation of the solar cells.

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4.0 Electrical Subsystems

4.1 and 4.2 Energy Supply, Pyrotechnics

The IST for the energy supply system and the pyrotechnics was carried out successfully on 6 December 1985 with participation by the project management team. All electrical specifications were able to be verified.

As part of the Milestone 5 (M5) Review held 10-12 December 1985 at DS, DS, using the verification document presented, TN-2002-2160 DS/019, along with other reference documents, was able to demonstrate successfully that both subsystems meet the specifications set. One of six deficiency notes produced deals with a still outstanding re-qualification of the solar generator with respect to the adhesive strength of the solar cells on a solar cell structure fabricated by MBB using the roller technique. This qualification test has been under preparation at AEG beginning in December 1985 and will be completed in February 1986.

With respect to status of the tasks and problems, it can be reported that

- the fabrication of the FM electronic boxes is on schedule despite some delay due to lack of HiRel parts
- no engineering problems have emerged in the fabrication of the FM electronic boxes
- fabrication of the FM solar generator has begun
- mechanical and electrical fabrication of the FM electronic boxes has been continued during some time delay in electrical fabrication due to lack of HiRel parts /12/
- mechanical fabrication of the FM battery housing has started
- all specifications of the subsystems have been reworked and reflect the latest design status taking into account all EC's set.

4.3 Cable Harness /13/

The project management also waived a status review on this subsystem in this reporting period based on the M5 milestone review.

From the monthly status reports from DS it can be determined that

- fabrication of the FM signal harness was continued
- fabrication of the FM power/pyro harness has been finished up to the "hot line" connector
- fabrication is completed on the FM telescope harness
- appropriate preparations have been made for testing of the harnesses
- the mass computations have been done for the complete FM cable harness
- the FM computer harness list has been reworked.

As part of the Milestone 5 (M5) review DS has demonstrated, in varification document TN-2002-2160 DS/019, along with other reference documents, that the harness meets all the specifications set for it.

With respect to schedule and problems, it can be reported that

- fabrication of the FM harness is on schedule
- no engineering problems have arisen in fabrication of the FM cable harness and in the incorporation of required modifications on the FM cable harness. /14/

4.4 Data Processing

After successful completion of the RF compatability tests at JSC the DPS was modified in conformity with some AE's and MRB's, and was then available according to plan for the remaining integration work, the pre-IST and finally the IST. During these activities also some defects were noted which were provisionally taken care of in the EM so that it was possible finally to finish the EM-IST.

However, to some extent these defects mean still larger modifications. For example, a header check of the incoming data frames is essential for the real-time handler in the DPS to prevent malfunctions of the DPS.
FM fabrication and installation of circuit boards is suffering from piece part delivery problems (especially ceramic condensors and RCA-SOS-RAM's), such that the previously planned FM delivery date (end of April 1986) can not be met. It has even been necessary, even in the FM to install as the first boards those with radiation sensitive Harries parts instead of the radiation hardened SOS-RAM's; this in order to get on with the program at all.

Both FM tape recorders have been successfully accepted at DS.

4.5 Data Transmission /15/

Tests on the data transmission system as part of the "Integrated System Test" showed that the integrated system meets the established specifications. Some confusion in the setting and definition of the modulation indices for both data channels which already cropped up during NASA interface tests remains to be cleared up.

- Transponder
  The ADP's were worked over, refined and presented at the M5 milestone review. A transponder was returned to the manufacturer at year's end to investigate instabilities in the modulation input which came out during the NASA interface tests. The reworking of both transponders and the necessary follow-up qualifications were agreed to both as to content and schedule.
- Decoder
  The EM integrated in the satellites (EM/STM) operated without problems.

The fabrication of the flight model has been slightly delayed by problems in the procurement of condensors for ROSAT.

- Antennas

The EM worked perfectly. The fabrication of the flight model was continued.

4.6 Attitude Measurement/Attitude Control /16/

- Star Sensor

The star sensor EM was subjected to a series of further tests: vibration, functional, performance tests. Evaluation of these tests has started.
The thermal budget of the star sensors was checked out for the worst case (orbit with the greatest heat radiation). The result shows a small rotation of the radiators is necessary. A precise analysis was carried out on the orientation of the radiators.

The measurement accuracy for the AKS stars was able to be considerably improved by the production of a supplementary correcting polynomial.

- Reaction Wheels

Fabrication of the mechanical parts of the reaction wheels is almost complete. The circuit boards for the WDE are finished and approved.

- AMCE

The AMC simulator for the static and dynamic subsystem tests is finished.

- Parts /17/

Despite the, in part, considerable delays in the delivery of some parts, it can be predicted that the individual components of the AMCS (up to the AMCD) can be delivered on schedule. One uncertainty here are the condensors. The AMCD delivery depends on the RCA parts delivery.

- Software

The development of further portions of the software (pointing mode) was able to be finished and underwent the first tests. The fabrication of the scan mode software is still pending.

5.0 Payload /18/

5.1 X-Ray Telescope

5.1.1 Telescope QM and FM

The telescope QM is being employed as part of the system AIT tasks.

Manufacture of components for the flight model of the telescope will be finished on time in spite of the late start in the fabrication, so that the schedule for FM telescope assembly will not be endangered.

5.1.2 Mirror System

The problem of the spots in the gold vapor deposition on the flight mirrors P3F and P4F has been solved. Improvements introduced in cleaning and spot-checking of mirrors before the vapor deposition have been tested for their effectiveness: the gold coating of P4F was washed off, the mirror cleaned and re-vapored. The gold coating is without any visible deficiencies.

With this, the improvement actions at the firm of C. Zeiss and Balzer to insure a zero defect preparation of the gold vapor deposition have been successfully verified.

The structural and engineering modifications in the cleanroom at C. Zeiss in which the flight mirror system is to be assembled and which were reported on in the previous reporting period, have been carried out; this is in order that in the future any hydrocarbon contamination of the mirrors is ruled out.
Despite the great extent of the work needed, it was /19/
finished in November 85 on schedule.
It is necessary to verify cleanliness before starting the

assembly of the flight mirror system. For this purpose there is employed a test program in which small gold-coated test mirrors are set out in the clean room and checked on a recurrent schedule. The first test with such test mirrors with the "SIMS" method yielded an unexpected result: Mirrors which had been gold coated in the same plant as the flight mirrors appeared to have incorporated hydrocarbons in the gold layer. This finding was confirmed with X-ray tests in the PANTER facility. The cause could be that, during the vapor deposition process, hydrocarbons from residual gas in the plant were picked up and embedded in the gold layer.

It can be assumed that this will also apply to the newly-coated P4F flight mirror. It is to be feared that without measurements to improve the gold vapor process itself, e.g. by suitable modification of the vacuum system at the vapor deposition facility, similar effects will apply to the gold vapor coatimg of further flight mirrors. At the moment checks are being made with the firm of C. Zeiss and Balzer as to what measures must be taken.

Since the introduction of these measures and the verification of their effectiveness will involve considerable expenditure of time, a new postponement of the start of assembly of the flight mirror system can be reckoned on.

The status of work on the contract at C. Zeiss for manufacture of the individual mirrors of the flight model which is separate from that of the overall system is as follows:

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All tasks have been successfully completed with the exception of the cutting to size of the not-yet-delivered flight mirror. Cutting to size and delivery have been deferred in order to be able to install the mirrors more securely in the supporting

structure.

5.1.3 Focal Plane Instrumentation

Tests of the FI as part of the system tests (IST) proceeded successfully.

The first assembly tasks of the FI flight model started during the reporting period.

Open problems were pursued further:

- HRI random vibration loads:
  New random loads for the HRI were derived by GSFC during the reporting period based on coupled analysis and using the data available from the telescope and FI vibration tests. These loads are significantly less than the previous system permissible levels, but they are higher than the magnitudes previously proposed by GSFC. It was agreed to test the HRI with the new loads. Before the random test, a sinus test should determine whether accelerations exceeding 27g occur on structural parts of the HRI; this is the loading during the HRI centrifuge tests. In this case, suitable notching must be planned.
  With this a decisive step will have been taken nearer to the solution of the problem.
- Slippages in the FI-FM: /21/
  MPE estimates the schedule delay for the delivery of the FI-FM at 6 months. It is planned to take the delay into account in reworking the schedule for the flight model of the satellite. Due to the problems with the mirror system and the associated required adjustments to the FM-AIT it can be expected that the FI-FM will be ready in a timely manner.

- Vacuum Loss on the HRI-EM
  After attachment of the HRI-EM to the structure and transport to MPE, the vacuum was restored by evacuation with supplementary pumps. A leak was not determined in the HRI-EM. A male plug connector in the electrical power supply cable for the HRI ion-getter pump was identified as the most probable cause of the collapse of the vacuum. The cable has been replaced.

  A new vacuum loss in the HRI-EM was discovered on 16 December 1985. It is supposed that the cause is defects in the buffer battery of the ion-getter pump power supply since the vacuum loss occurred after a (planned) shutdown of the house power.

  Subsequent determination of the failure cause and its correction are pending. It is planned together with GSFC to introduce improvement in the reliability of the power supply.

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5.2 Wide Field Camera (WFC)

- Activities during the reporting period:
  - o IST successfully finished
  - o routine interface meeting at DS, as part of the status meetings, 13-15 November
  - o information exchange re: possible EVA's
  - o preparations for the solar simulation test
- Prospects:
  Agreement on modified readiness dates (FM) with DS based on the new AIT planning

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6.0 Assembly, Integration and Test

Integrated System Test of the EM

The outstanding occurrence in the reporting period was the carrying-out of the Integrated System Tests (IST).

Electrical satellite and EGSE equipment functions were successfully verified.

The focal plane instrumentation (FI) of the telescope and the wide field camera was operated by the experimenters through the S/C EGSE using their own programs based on mission-similar conditions, and was successfully tested in all planned functions.

The S/C EGSE and checkout software met the specifications for function and compatibility with the overall system.

The data attained in the IST will also serve as reference data in subsequent testing.

IST Follow-on Test

For the first star sensor, delivered during the IST, the test was carried out afterwards. A test will be repeated in May for the AMCS software, up until now incomplete.

Integration and Test of the EM

The tasks of integration, alignment and optical measurements on the WFC, the FI, the AMCS sensors such as magnetic coils,

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wheels, star sensors, on the antenna booms and magnetometers were

all able to be handled according to plan.

Integration tasks had to be interrupted for four days on account of the delayed delivery of the AMCS. During the electrical integration, I/F problems arose between the AMCS computer and the S/C EGSE.
Considerable problems arose in the pre-IST of the FI on account of I/F errors in the S/C data processing (DHS). The errors were explained and eliminated through joint efforts of DS, S/C operators and the experimenters from MPE.
In order to make up for the time delays that arose, shift work was employed beginning in mid-November and thermal hardware was adjusted and integrated in parallel with this.
All problems were disposed of before the IST began, and no failure reports are pending which would call into question the success of the IST.

Prospects

Solar simulation testing of the EM at IABG, 7 January to 5 March 1986.

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7.0 Ground Support Equipment

7.1 Electrical Ground Support Equipment

A reworking of the test sequences was undertaken for the pre-IST and the integrated system test (IST). The electrical integration of the AMCS was supported. The monitor table was updated.
The new version of the ETOL software was implemented by ESOC in the EGSE computer and the errors that occurred were corrected.
The EGSE specification was revised.

Hard and software problems which occurred on the IEEE bus, the

S/C EGSE and the AMCS-EGSE were eliminated. The acceptance of the EGSE and the checkout software took place simultaneously with the IST. Service programs were prepared for support of the AIT. The latest version of the send/receive tasks from the S/C EGSE was made available to GSOC. Still to be investigated are the effects on the data compatibility test (Gateway/DEC net) of the delayed delivery of the Micro VAX II* to GSOC.

The analog device delivered by MPE is defective.
It has been turned over to the supplier for repair.

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7.2 Mechanical Ground Support Equipment

Most of the tasks in the MGSE subsystem have been completed. The test adapter for the IABG-WSA was completed and delivered.
After production of the manuals and test protocols and the work on failure reports, no more activities will take place.

7.3 Optical Ground Support Equipment

No activities.

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* manufacturer's name for the computer employed

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8.0 Mission Safety

o STS Safety

The "Safety II Review" for the overall ROSAT system was carried out at NASA-JSC and NASA-KSC on the basis of the GSFC-approved data packet for STS flight and ground operations which was accepted by NASA JSC/KSC for review.

The results are essentially as follows:

oo Flight Operations:
- a number of hazard reports submitted in Phase II (seven for the ROSAT system, four for the S/C, four for the FI, and five for the WFC) were approved.

oo Ground Operations:
- Of the eight (8) hazard reports submitted to the "Review Team" from NASA KSC for Phase II, six were approved and two were not approved. These must be resubmitted in revised form.

o Reliability

Meantime a number of FMECA's and SPF lists for the system and subsystems have been delivered by DS. The project management has started with an anaylsis/checking of the FMECA's.

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o Quality Assurance

oo During the reporting period, the project management checked and evaluated altogether 24 further failure reports/MRB's of Level 2 on the EM and FM components of the satellite system.

oo There was a total of three inspections following final checks of double-sided circuit boards at the firms Teldix and MBB

o Central Parts Procurement

oo Passive Parts

- All LI's to and including all ceramic condensors of the Jahre firm which, on account of cracks in the ceramic bodies, had to be ordered again from other manufacturers either from stock (LCC Co.) or new production (Union Carbide), have been distributed to the users.
The delivery of all replacement and/or newly ordered ceramic condensors will be finished in the fifth calendar week of 86.

oo Active Parts

- All diodes and all transistors through Type MAT 01 have been distributed.

- For those IC's which can no longer be delivered in 1985 due to delivery problems of the manufacturer, cancellation or modification of test times in "upgrading" and to lack of timely replacement procurement, there will be some considerable delivery postponements in 1986.

9.0 Vehicle Interface /29/

o ICD-A-18410

- As part of the NASA interface discussions at NASA JSC on 1 October 1985, the "preliminary version" of the ICD produced by NASA and reviewed by DS was a subject for discussion. As a result of these discussions a "baseline version" signed by NASA JSC and the project managements at GSFC and DFVLR was adopted.

- The second part of the "Design Review" (DR) of the ROSAT/OIB was carried out on 3 October 1985.

o PIP Annexes

- PIP Annex 4: Based on the agreement reached NASA, JSC produced a preliminary version which has been commented on by the project management in a so called "red marked copy".
- PIP Annex 5: This annex was finally discussed with NASA on 3 October 1985 and meanwhile the project management has a "preliminary version" for comment.

PIP Annex 8: The "Launch Site Support Plan" (LSSP) and the associated PRD were discussed as part of the NASA interface discussions at NASA KSC. The results of this discussion were incorporated by NASA KSC into the document.

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o Suitcase Test at NASA JSC

At NASA JSC the appropriate compatibilities of the ROSAT RF-system ("Van" Test) were carried out with the NASA ground stations using the test vehicle ("van") furnished by NASA GSFC. The "down-link" test was successful, the "up-link" test, however, could not any longer be continued due to technical problems with the "van". The compatibility tests will be repeated as part of launch preparations.

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10.0 Mission Operations

10.1 Progress of Work

The important milestone in the reporting period just past was the successful carrying-out of the "Mission Operations Requirements Review" on 5 December 1985. But here it became clear that the

buildup of the ROSAT ground segment has been in part seriously hindered in some areas by the non-availability of information.

Coordination

Several requirements for the mission operations system are not covered in the present budget planning and this must be handled. Additional costs are to be expected. Steps were introduced for improved coordination of GSOC activities and the course of the work at DS. The manpower shortage at GSOC was not able to be eliminated at the end of 1985 and this is to be taken into account in following years with respect to planning.

Flight Operations

The Mission Operations Requirements Review was carried out on the basis of the first "preliminary" Experiment Operations Requirements Document (EORD) of 4 November 1985, of the GSOC-ROSAT Project Requirments Document (PRD) and the pertinent satellite specifications. In this connection, "Mission Operations Meetings" (MOM) have been set up with DS in order to be able on a regular basis to discuss open questions concerning the satellite/ground interfaces. The "Mission Operations Support /32/ Plan" could not be started. Participation took place in the "WFC Preliminary Design Review".

Ground Operations

The ROSAT-PRD was completed in preliminary form and is being submitted to an approval process at the moment at GSOC.
The draft of the SIRD submitted by NASA takes into account the support functions desired by the project.
For a test of the receiving readiness at the 15m ground station at Weilheim for 1 MBPS telemetry, the IRAS satellite was activated by RAL, Chilton, UK and made available to GSOC.

Mission Planning and Analysis

The main activities centered around preparation of detailed specifications as a basis for the software design of the attitude measaurement/control software. The main program of the attitude determination software has been developed. The definition of the requirements in the area of mission planning was further deepened.
An analysis of the satellite antenna aspect angle behaviour showed that no significant reduction in data reception is to be expected as a result of antenna pattern breakins.

Data System

The ground station software was modified for the processing of data rates up to 250 kbps for manipulation of the 1 MBPS telemetry data registered in the analog band.
Intersection point adjustments of the command software were defined for the acceptance of external command files. A start

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was made on working up a concept for command verification (from telemetry).
The software specification was prepared for the GSOC/ROSAT data

system interface tests (DS/IABG-GSOC boundary).
The testing of the concept for the development of DV requirements for ROSAT and other projects in future years presented by WT-DV led to a modification of ROSAT specifications which should result in a cost reduction in the WT-DV concept.

AMCS Simulator

A first version of the "Dynamic Sensor and Actuator" software was delivered by RAL and tested. Essentially the tasks are proceeding according to plan. To bridge over the lack of the AMCD and simulator interface hardware, first expected in February 1986, an unplanned software simulation package had to be developed in order not to impede the integration and test work. Accordingly, the development of the simulator system software was lagging behind the schedule.

Test and Training

No activities.

Software

After first analyses of the requirements in the EORD, the definition began of the intersection points in the attitude, orbit, commnand and mission planning data sets. A description was prepared of the telemetry-data basis system. A preliminary design was presented of the "Special Master Data Record" (SMDR).

10.2 Problems

The acceptance of the telemetry and command data basis of the satellite EGSE (ETOL) into the GSOC data system requires clarification since it represents a prerequisite for the configuration of the GSOC ROSAT telemetry/command software. Confusion about the previous definition of requirements and lack of information led at GSOC to 1985 activities being put over until 86, which still can be handled from a personnel standpoint. Important delays in some areas arose in the development of attitude determination/attitude control software on account of some delays in delivery of documents and specifications and software to be made available by project management. The delayed delivery of the AMCD simulator hardware and the associated interface system is leading to delays in the development of the AMCS simulator.

10.3 Personnel Status

See Annex 13.1

10.4 Schedule

Postponements in the GSOC schedule cannot be avoided due to the problems named in the above report. Changes from the last schedule dated 18 June 85 are indicated with marginal notes. On account of the holdover of activities into 1986/87, the influence on operational readiness at launch date still remains insignificant. However, this can only be guaranteed if the existing manpower deficit is removed and is appropriately taken into account in the future in planning estimates.

11.0 Schedule /35/

- Nominal Specified
  The nominals layed out in the contract milestone plan with a launch date of 30 October 1987 no longer agree with the actual status. The same applies for the NASA schedule in the PIP with the launch date (reference milestone "ready for launch") at 30 September 87.
- EM Actual Status
  The currently valid DS schedule for STM integration dated 6 November 85 shows, when compared with the previous plan of 7 May 85, the same termination point with closeout of the structural updating on 7 July 1986. Only operating sequences have been switched around. Milestone M5 was met according to plan. Design Review 2 is scheduled for May 1986.
- FM Actual Status
  At the management discussion in November DS presented a planning proposal, status 12 November 1985, which currently is serving as a basis for the work. In this planning proposal, the four-week buffer before transporting the flight unit to the launch site is no longer included. Taking into account the delayed readiness of the flight mirror system caused by contamination problems in the gold vapor deposition, and delays in parts procurement, the following slips appear in the milestones:

M7,	readiness of flight mirror system:		4 months
M8,	FM ready for environmental tests :		4 months
M9,	preshipment review	:	3 months
M10,	launch	:	2 months

/36/

Binding schedule planning with a modified milestone plan has been agreed with DS to take place at the end of February 1986 after the close of the solar simulation tests.

With restoration of the four week buffer, this binding milestone plan shows a launch date in the first quarter of 1988.

DFVLR

Deutsche Forschungs-und Versuchsanstalt für Luft-und Raumfahrt e.V.

- BEREICH FÜR PROJEKTTRAGERSCHAFTEN -

FREIGABE: (B)

BEARBEITUNG: (C)

MEILENSTEINPLAN (D)

ROSAT (E)

EM, QM, STM, ENTW., FERTIGUNG, S/S-TESTS, AIT

PROJEKTLEITER (F)

STUFE (G)

BLATT (L) VON (M)

ORIGINALPLAN VOM: DR I (H) (I)

LETZTE ÄNDERUNG: (J)

STICHTAG: 31. 12. 1985 (K)

	MEILENSTEINE UND AKTIVITÄTEN (N)
1	RAUMFAHRZEUG ENTWURF
2	M2 DESIGN REVIEW I
3	UNTERSYSTEM (SIS) ENTWICKLUNG
4	FERTIGUNG EM, QM
5	S/S TESTS EM, QM
6	AIT TELESCOPE QM
7	EM-BEISTELLUNG MA,(M3) FI, WFC
8	AIT BUS EM
9	ROSAT INTEGRATION
10	M4, ROSAT FERTIG ZUM MODAL SURV. TEST
11	MODAL SURVEY TEST
12	RF SUIT CASE TESTS JSC (J), GSOC (G)
13	PRE IST, IST
14	EMC TEST
15	SOLAR SIM TEST
16	M5, DESIGN REVIEW 2
17	M6, RAUMFAHRZEUG AUSEINANDERBAU
18	AUSEINANDERBAU STM
19	STRUKTUR ÜBERHOLUNG

1983 1984 1985 1986 1987

J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

MA WFC FI

M5 DR 2

BEMERKUNGEN: (O) ..... : DRI – PLANUNGSSTAND (P) (P) : PLANUNGSSTAND 6. 11. 85 : IST-ZUSTAND (Q)

TERMS FOR PAGE 37 ON NEXT PAGE

TERMS FOR PAGE 37

(NOTE: Line items in English not listed. Line items in German bear identical numbers below to those in the original.

A. German Research and Test Establishment for Aeronautics and Space Flight
B. Approved
C. Prepared by
D. Milestone Plan
E. EM, QM, STM, Design, Fabrication, S/S Tests, AIT
F. Project Manager
G. Level
H. Initial Plan
I. dated
J. Last Change
K. Status as of
L. Page....
M. of.....
N. Milestones and Activities
O. Notes
P. Planning Status
G. Actual Status

Milestones and Activities

1. spacecraft design
3. subsytem (SIS) development
4. fabrication
7. EM readiness
10. M4 ROSAT ready for modal survey test
17. M6, spacecraft disassembly
19. structural overhaul

DFVLR

Deutsche Forschungs-und Versuchsanstalt (A)
für Luft-und Raumfahrt e.V.
- BEREICH FÜR PROJEKTTRÄGERSCHAFTEN -

FREIGABE: (B)
BEARBEITUNG: (C)

MEILENSTEINPLAN (D)

ROSAT

FM FERTIGUNG
S/S TESTS, AIT (E)

STUFE (G)

PROJEKTLEITER: (F)

BLATT (L)

VON (M)

ORIGINALPLAN VOM: DRI (H) (I)

LETZTE ÄNDERUNG: (J)

STICHTAG: 31. 12. 1985 (K)

	MEILENSTEINE UND AKTIVITÄTEN (N)	
1	FERTIGUNG	FM
2	S/S TESTS	FM
3	M7, BEISTELLUNG	MA
4	BEISTELLUNG	FI
5	BEISTELLUNG	WFC
6	AIT TELESKOP	FM
7	AIT BUS	FM
8	ROSAT INTEGRATION	FM
9	M8 ROSAT FM FERTIG FÜR UMWELT TESTS	
10	EMC-, TV-, ACOUSTIC NOISE TEST	
11	KOMPATIBILITÄTSTEST GSOC	
12	TELESKOP X-RAY PERFORMANCE TEST	
13	FINAL IST	
14	M9 PRESHIPPING REVIEW	
15	TRANSPORT ZUM KSC	
16	KSC STARTVORBEREITUNG	
17	M10 START	

1984 1985 1986 1987 1988

J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

BEMERKUNGEN: (O)

DRI-PLANUNGSSTAND (P)

PLANUNGSSTAND 12. 11. 85 (P)

IST-ZUSTAND (Q)

TERMS FOR PAGE 38 ON NEXT PAGE

TERMS FOR PAGE 38

(NOTE: Line items in English not listed. Line items in German bear identical numbers below to those in the original.

A. German Research and Test Establishment for Aeronautics and Space Flight
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E. EM, QM, STM, Design, Fabrication, S/S Tests, AIT
F. Project Manager
G. Level
H. Initial Plan
I. dated
J. Last Change
K. Status as of
L. Page....
M. of.....
N. Milestones and Activities
O. Notes
P. Planning Status
G. Actual Status

Milestones and Activities

1. fabrication
3. M7, readiness date
4. readiness date
5. readiness date
9. M8 ROSAT FM ready for environmental testing
11. compatibility test GSOC
15. transport to KSC
16. KSC launch preparations
17. MIO launch

/39/40/41/

PAGES 39, 40 AND 41 ARE IN ENGLISH

PAGES 41-57 WERE LIMITED DISTRIBUTION- NOT IN THIS PACKAGE

/57/

13.0 Annexes

13.1 Personnel Employment at DFVLR-RF-TN and DFVLR-RF-RH

RÖNTGENSATELLIT

1. Personaleinsatz DFVLR-PT

(Mannmonate) 2.

STATUS: 31.12.85

	3. ZEIT-RAUM	4. SOLL	5. IST	3. ZEIT-RAUM	4. SOLL	5. IST	3. ZEIT-RAUM	4. SOLL	5. IST	3. ZEIT-RAUM	4. SOLL	5. IST
Kat. I	12/84	13.0	8.2	1/85	13.5	8.1	2/85	13.5	8.6	3/85	13.5	9.1
Kat. II	=====	3.5	0.9	====	3.5	1.0	====	3.5	1.0	====	3.5	1.0
Kat. III		4.0	4.1		4.0	3.5		4.0	3.1		4.0	3.4
Insgesamt - 6		20.5	13.2		21.0	12.2		21.0	12.7		21.0	13.5
Kat. I	4/85	13.5	9.3	5/85	13.5	9.6	6/85	13.5	10.8	7/85	13.5	10.2
Kat. II	====	3.5	1.1	====	3.5	1.1	====	3.5	1.1	====	3.5	1.0
Kat. III		4.0	3.9		4.0	3.9		4.0	3.7		4.0	3.7
Insgesamt - 6		21.0	14.3		21.0	14.6		21.0	15.6		21.0	15.2
Kat. I	8/85	13.5	12.1	9/85	13.0	12.7	10/85	13.0	10.7	11/85	13.0	10.3
Kat. II	====	3.5	0.9	====	3.0	1.1	=====	3.0	1.1	=====	3.0	0.9
Kat. III		4.0	3.1		4.0	3.0		4.0	3.2		4.0	2.7
Insgesamt - 6		21.0	16.1		20.0	16.8		20.0	15.0		20.0	13.9
Kat. I	12/85	13.0	10.6									
Kat. II	=====	3.0	1.1									
Kat. III		4.0	3.1									
Insgesamt - 6		20.0	14.8									

TERMS FOR PAGE 58 ON NEXT PAGE

TERMS FOR PAGE 58

1. Personnel Employment
2. Man Months
3. Time Period
4. nominal
5. actual
6. Total

RÖNTGENSATELLIT

1. Personaleinsatz DFVLR- RF-RM 2.

Mission Operations Kostenträger 2885007

STATUS: 31.12.1985

	3. ZEIT-RAUM	MM 4. SOLL	MM 5. IST	3. ZEIT-RAUM	MM 4. SOLL	MM 5. IST	3. ZEIT-RAUM	MM 4. SOLL	MM 5. IST	ZEIT 3. RAUM	MM 4. SOLL	MM 5. IST	SUMME 1985 SOLL 4.	IST 5.
Kat. I	1-9/85			10/85	4.5	3.9	11/85	4.5	5.1	12/85	4.5	6.1		
Kat. II	"			"	6.0	3.0	"	6.0	3.2	"	6.0	3.1		
Kat. III	"			"	1.0	0.3	"	1.0	0.3	"	1.0	0.4		
Insgesamt (MJ) — 6.	"	103.5	55.4	"	11.5	7.2	"	11.5	8.6	"	11.5	9.6	138.0	80.8
7. Fremdleistungen: Budgetiert 1985: 710.000,-- DM	≙	3,5 MJ — 7A.												
8. Verfügt bis 31.12.85: 672.480,-- DM	≙	3.36 MJ — 7A.												
9. Ergibt in Leistung:	1-9/85			10/85			11/85			12/85				
Soll-geplant	"	31.5		"	3.5		"	3.5		"	3.5		42.0	
Ist-Vertrag	"		25.5	"		5.0	"		5.0	"		5.1		40.6

TERMS FOR PAGE 59 ON NEXT PAGE

TERMS FOR PAGE 59

1. Personnel Employment
2. Cost citation
3. Time Period
4. nominal
5. actual
6. Total
7. Out-of-house work:
   Budgeted 1985

7A. Man years

8. Expended through 31 Dec 85
9. Produced in work:
   nominal--planned
   actual---contracted

ROENTGENSATELLIT

Personaleinsatz DFVLR- RF-RM

SIMULATOR Kostenträger 3885406

STATUS: 31.12.1985

	3 ZEIT-RAUM	MM 4. SOLL	MM 5. IST	3. ZEIT-RAUM	MM 4. SOLL	MM 5. IST	3. ZEIT-RAUM	MM 4. SOLL	MM 5. IST	3. ZEIT-RAUM	MM 4. SOLL	MM 5. IST	SUMME 1985 SOLL 4.	IST 5.
Kat. I	1-9/85			10/85	1.5	1.5	11/85	1.5	1.3	12/85	1.5	1.3		
Kat. II	"			"	-	0.5	"	-	0.8	"	-	0.9		
Kat. III	"			"	-	-	"	-	-	"	-	-		
Insgesamt (MJ) 6.	"	13.5	17.6	"	1.5	2.0	"	1.5	2.1	"	1.5	2.2	18.0	23.9
7 Fremdleistungen:														
. Budgetiert 1985:	1.400.	000,--	DM ≙	7.0 M	J									
8. Nach Mittelverschiebung	auf 1986 verbleiben für 1985: 1.126.453,-- DM ≙ 5.7 MJ laut Mittelbewilligung des BMFT v. 2.12.85													
. Verfügt bis 31.12.85:	1.192.	170,--	DM ≙	5.9 M	J									
9														
10 Ergibt in Leistung	1-9/85			10/85			11/85			12/85				
Soll-geplant	"	63.0		"	2.0[1]			1.0[1]			1.0[1]		67.0	
Ist-Vertrag	"		43.0	"		10.0[2]			10.0[2]			8.0[2]		71.0

11.

1) Soll-Reduzierung im Zusammenhang mit Mittelverschiebung
2) Ist-Überhöhung wegen Nachholarbeiten aus 1-9/85

TERMS FOR PAGE 60 ON NEXT PAGE

TERMS FOR PAGE 60

1. Personnel Employment
2. Cost citation
3. Time Period
4. nominal
5. actual
6. Total
7. Out-of-house work:
   Budgeted 1985

7A. Man years

8. After spending deferral to 1986, for 1985 there remains (numbers)...per spending authority document, BMFT, 2 Dec 85.
9. Expended through 31 Dec 85
10. Produced in work:
    nominal--planned
    actual---contracted
11. 1) reduction in nominal associated with spending deferral
    2) increase in actual on account of tasks done over again in period 1-9/85

13.2 Table of Abbreviations

ABM	Antenna Boom Mechanism
ADP	Acceptance Data Package
ÄA	Change Proposal
AKS	Pointing Control-System
AIT	Assembly, Integration and Test
AMCD	Attitude Measurement and Control Data Unit
AMCE	Attitude Measurement and Control Interface Electronics
AMCS	Attitude Measurement and Control Subsystem
BAT	Battery
BCU	Battery Control Unit
Bit. Sync.	Bit Synchronizer (Synchronization)
BMFT	Bundesminister für Forschung und Technologie (Federal Minister for Research and Technology)
CCD	Charge Coupled Device
CCL	Charge Current Limiter
C&DH	Command and Data Handling
CEL	Control Electronics
CFK	Carbon Fiber Reinforced Plastic
CFRP	Carbon Fiber Reinforced Plastics
CITE	Cargo Integration Test Equipment
Cmd	Command
CMOS	Complementary Metaloxyde Silicon
C/O	Checkout
CPP	Central Parts Procurement
CPU	Central Processing Unit
CSA	Charge Solar Array
CSS	Coarse Sun Sensor
CZ	Firma Carl Zeiss

DC	Direct Current
DEC	Decoder
DFVLR	German Research and Test Establishment for Aeronautics and Space Flight
DFVLR-PL	DFVLR-Project Management
DHS	Data Handling Subsystem
DMA	Direct Memory Access (Direct Assess to Memory)
DMOD	Demodulator
DNEL	Disconnection of Non-Essential Loads
DPS	Data Processing System
DR	Design Review
DS	Dornier System
DV	Data Processing
EAC	Estimate At Completion
ECR	Engineering Change Request
ECS	Environmental Control System
EED	Electro-Explosive Device
EEL	Experiment-Electronics
EGSE	Electrical Ground Support Equipment
EM	Engineering Model
EMC	Electromagnetic Compatibility
EOL	End-of-Life
EORD	Experiment Operations Requirements Document
EPD	External Power Dumper
ESA	European Space Agency
ETOL	ESA Test Operation Language
EUV	Extreme Ultraviolet
EVA	Extravehicular Activity
FEM	Finite Element Model
FI	Focal Plane Instrumentation

FLS	Fiducial Light System
FM	Flight Model
FMECA	Failure Mode Criticallity Analysis
FWHM	Full Width at Half Maximum
GF	Grapple Fixture
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
GSOC	German Space Operations Center
GVS	Gas Supply System
GYP	Gyropackage
GYPE	Gyropackage Electronics
GYPS	Gyropackage Sensor
HC	Heater Control
HEAO-2	High Energy Astronomy Observatory ("Einstein")
HIREL	High Reliability
HK	Housekeeping
HP	High Power
HRI	High Resolution Imager
IABG	Industrial Facilities Operating Co.
IC	Integrated Circuit
ICD	Interface Control Document
IEEE	Institute of Electrical and Electronics Engineers
INVAR	(trade name for a particular steel alloy)
IST	Integrated System Test
JSC	Johnson Space Center
kbps	Kilobit per second (deutsch: kbit/s)

KSC	Kennedy Space Center
KW	Calendar Week
LCL	Latching Current Limiter
LED	Light Emitting Diode
LHC	Left-hand Circulation
LI	Line Item
LP	Low Power
MA	Mirror Assembly
MAC	Mirror Attachment Cone
Mbps	Megabit per second (deutsch: Megabit/s)
MC	Magnetic Coil
MCC	Mission Control Center
MCP	Microchannel Plate
MDM	Multiplexer/Demultiplexer
MED	Magnetic Electron Deflector
MES	Mechanisms Subsystem
MGSE	Mechanical Ground Support Equipment
MIP	Mandatory Inspection Point
MLI	Multilayer Insulation
MM	Magnetometer
MM	Mass Model
MOM	Mission Operating Meeting
MOU	Memorandum of Understanding
MPE	Max-Planck-Institut für Physik und Astrophysik, Institut für Extraterrestrische Physik
MPG	Max-Planck-Gesellschaft
MPSS	Mission Planning and Scheduling System
MRB	Material Review Board
MSA	Main Solar Array
MSSL	Mullard Space Science Laboratory

MUC	Multi-Use Container
MUDAS	Modular Universal Data Acquisition and Control System
MVL	Main Voltage Limiter
NASA	National Aeronautics and Space Administration
NCR	Non Conformance Report
NRZ/L-Code	Non-Return-to-Zero/L-Code
NSI	NASA Standard Initiator
OBC	Onboard Computer
OGSE	Optical Ground Support Equipment
OIB	Orbiter Interface Box
OSR	Optical Surface Reflector
PCB	Printed Circuit Board
PCU	Power Control Unit
PDU	Power Distribution Unit
PETS	Payload Environmental Transportation System
PGHM	Payload Ground Handling Mechanism
PHP	Paraboloid-Hyperboloid Pair
PIP	Payload Integration Plan
POCC	Payload Operations Control Center
PPF	Payload Processing Facility
PRD	Program Requirements Document
PRD	Project Requirements Document
PSE	Payload Support Equipment
PSK	Phase-shift Keying
PSPC	Position Sensitive Proportional Counter
PSS	Power Supply Subsystem
PYB	Pyrotechnics Electronic Box

QM	Qualification Model
RAL	Rutherford Appleton Laboratory
RAM	Random Access Memory
RCA	Radio Corperation of America
RE	Radiated Emission
RF	Radio Frequency
RfW	Request for Waiver
RMC	Right-hand Circulation
RMS	Remote Manipulator System
ROSAT	Röntgensatellit
RS	Radiated Susceptibility
RSGF	Rigidized Sensing Grapple Fixture
RSS	Rotating Service Structure
RT	Real Time
RW	Reaction Wheel
RX	Receiver
S/C	Spacecraft
SCOE	Special Checkout Equipment
SERC	Science & Engineering Research Council
SEU	Single Event Upset
SIRD	Support Interface Requirements Document
S/L	Serial Load
SMDR	Special Master Data Record
SOC	Science Operations Center
SOS	Silicon on Sapphire
SPF	Single Point Failure
SPL Code	Split Phase Level Code
SSM	Single Surface Mirror
SSM	Separation Switch Mechanism
ST	Star Tracker

STC	Star Tracker Camera
STE	Star Tracker Electronics
STM	Structural Thermal Model
STS	Space Transportation System
SURS	Shuttle Umbilical Retraction System
S/W	Software
TA	
TC	Telecommand
T/C	Thermal Control
TCE	Thermal Conditioning Equipment
TCS	Telecommunication Subsystem
TDM	Telescope Door Mechanism
TM	Telemetry
TR	Tape Recorder
TT & C	Telemetry, Tracking and Command
TV	Thermal-Vakuum
TX	Transmitter
UK	United Kingdom
US	Subsystem
VPHD	Vertical Payload Handling Device
VPF	Vertical Processing Facility
WDE	Wheel Drive Electronics
WFC	Wide Field Camera
WFCC	WFC-Consortium
WSA	
XRT	X-Ray Telescope

ZERODUR	(trade name for the glass/ceramic material of the mirror)
ZDE	Central Data Electronics